

Zhejiang Tongzhu Technology Co. , Ltd

BMS serial communication protocol

(Version: A5)

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1. Statement

This agreement is formulated by the R&D department and is applicable but does not cover all BMS products. Due to factors such as feature upgrades or product updates, we may amend this agreement without notice. If your product can only recognize our specific agreement version, please specify it in the purchase order.

The focus of this agreement is to describe the frame format and data application. It only puts forward general requirements for baud rate, error correction, format, etc., but does not specify the physical and link. If you want to transmit this protocol on the circuit you built, please contact us to discuss the feasibility.

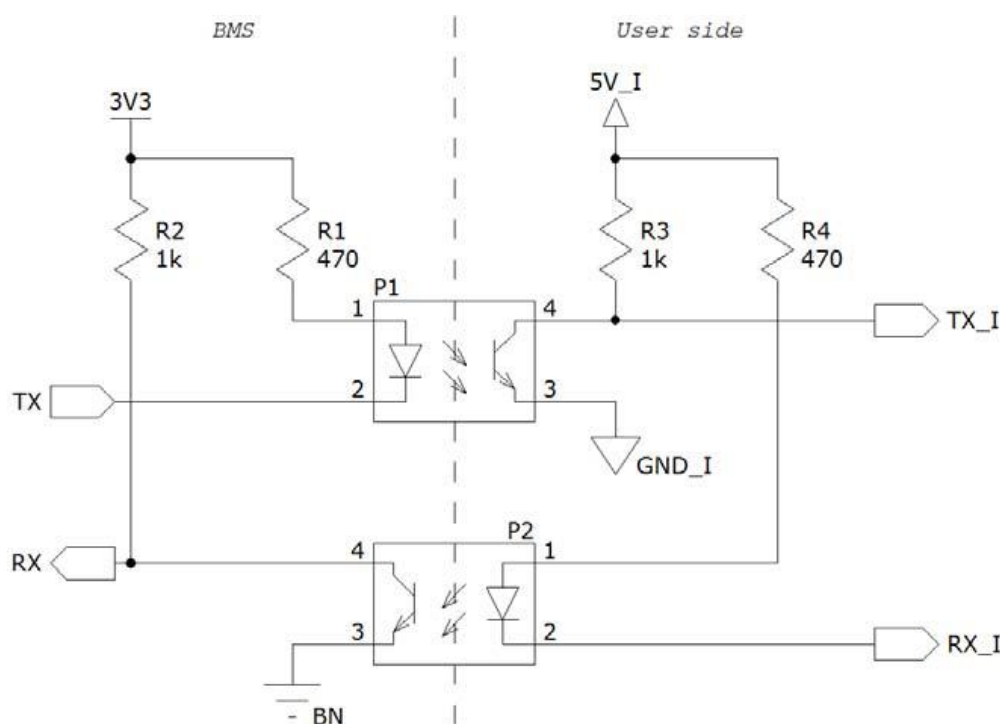
2. Agreement overview

- Applicable to half-duplex UART and 485.
- 9600bps, 8N1, RTU.
- Data types exceeding 1 byte are transmitted in little endian mode.
- Response system: when the host sends an inquiry command, only the corresponding address slave will respond.
- Keep at least one idle character (broken frame) before the command frame, and there is no idle character (broken frame) before the response frame.

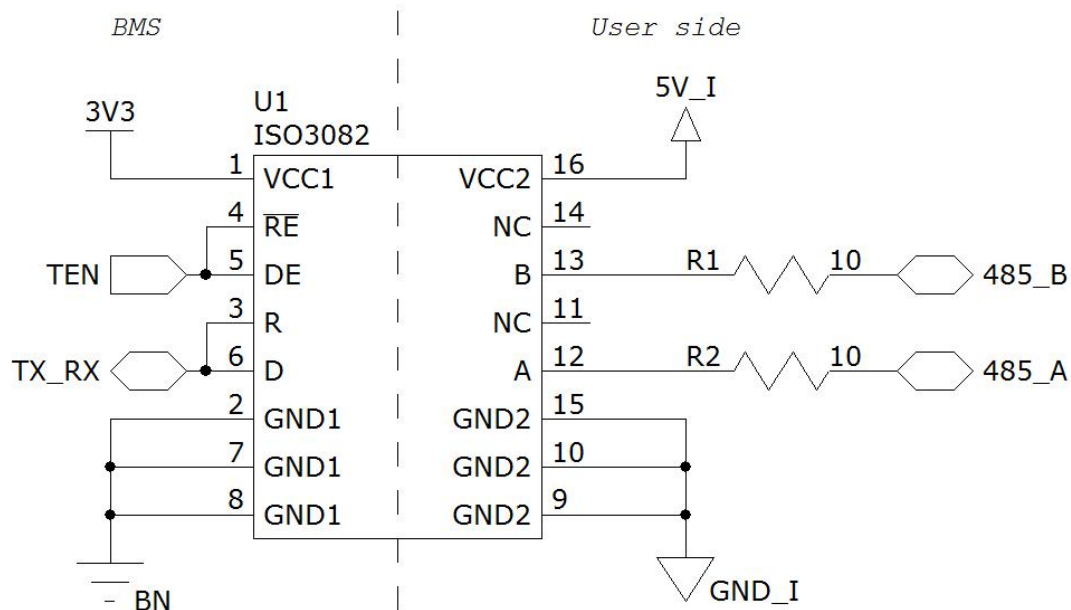
3. Interface circuit

The circuit shown in this chapter is a typical circuit for industrial applications, and it is not mandatory for reference.

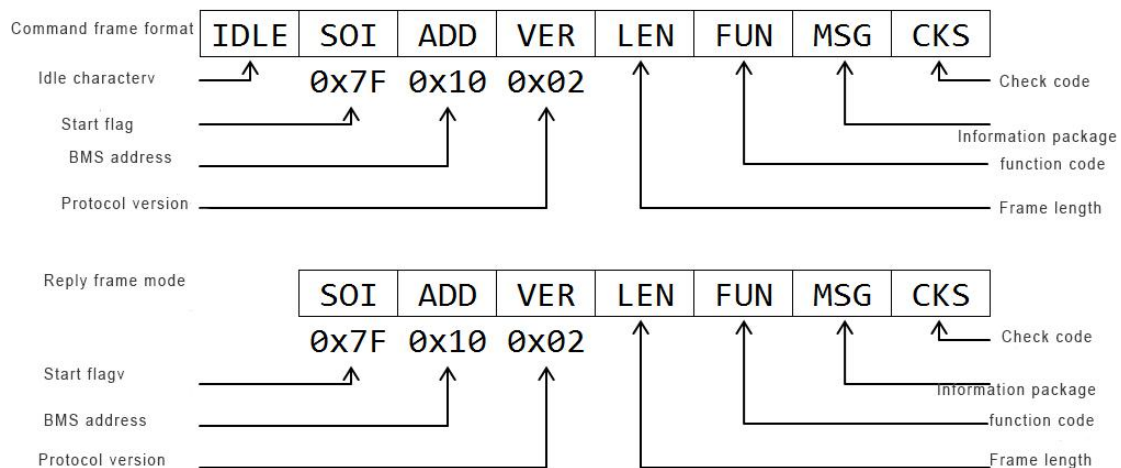
3.1 Schematic diagram of isolated UART



3.2 Schematic diagram of isolated 485



4. Frame format definition



- "SOI" is the start mark, which is fixed at 0x7F.
- "ADD" is the BMS address, which is fixed at 0x10.
- "VER" is the protocol version number, the current version is 0x02.
- "LEN" is the length declaration, used to declare the frame data length, counted in bytes, including the sum of the lengths of SOI, ADD, VER, LEN, FUN, MSG, and CKS.
- "FUN" is the function code, used to declare the operation to be performed (or performed) by the BMS.
- "MSG" is an information packet with variable length. Data can be passed, execution results can be passed, or the field can be canceled.

➤ "CKS" is the check code, which is used by the receiving end to check the contents of this transmission (including SOI, ADD, VER, LEN, FUN, MSG). The checksum is the complement of the cumulative sum of each byte.

➤ For a detailed description of "FUN" and "MSG", please refer to the subsequent chapter "Instructions, Parameters and Responses".

5. Response management

5.1 No response

Any command frame (SOI error, ADD error, LEN error, FUN does not exist, MSG and FUN definition range, CKS error) beyond the scope described in this article will cause no response. The host computer does not receive the data within 50 milliseconds after sending the command, it means no response.

5.2 Error response

If the "FUN" or "MSG" sent by the host computer is parsed incorrectly, the "FUN" in the response frame returned by the BMS

Expressed as 0x00, cancel the "MSG" field.

5.3 Execution response

When the host sends an instruction to the lower computer to perform something, and the lower computer returns a response (not returning data) indicating "correct execution" or "error execution", the length is declared as 0x07.

- Correct execution: The response content is (uint8_t)0x01.
- Execution error: The response content is (uint8_t)0x02.

5.4 Version management

- Only applicable to the host computer and the BMS protocol version are higher than (or equal to) 0x02, but the host computer and BMS Inconsistent protocol versions.
- If the protocol version sent by the host computer is inconsistent with the current version of the BMS, the BMS will fill in its own version number in the corresponding position of the response frame.
- If both "FUN" and "MSG" sent by the host computer can be parsed in the current version of BMS, BMS
- Analyze and execute according to the normal process.

6. Instructions, parameters and responses

- Note 1: The "command" in this section corresponds to "FUN", "parameter" refers to the "MSG" sent by the host computer to the BMS, and the response refers to the "MSG" sent back by the BMS to the host computer.
- Note 2: The examples in this section only involve commands, parameters and responses, which does not mean that "SOI", "ADD", "VER", "LEN", and "CKS" can be ignored in actual applications.

- Note 3: The command "Monitor 3" is recommended to be used in the communication between the computer host computer or mobile phone APP and the BMS; the command "Monitor 2" is recommended to be used in the communication between the motor controller (or other system controllers) and the BMS.
- Note 4: Unless otherwise stated, the numbers in the examples are all expressed in hexadecimal numbers.

6.1 Monitoring 3

6.1.1 Command: 0x12.

6.1.2 Parameters: None.

6.1.3 Response: the response contains the following paragraphs (arranged in order in the frame structure).

- Battery status information.
- Current value.
- Number of battery strings.
- Battery voltage.
- Balanced state.
- The number of batteries' temperature sense.
- Battery core temperature.
- The number of MOSFET temperature sensing.
- MOSFET temperature.
- Number of cycles.
- Remaining power.
- Total capacity.
- Switch state.

6.1.3.1 "Battery Status Information" is composed of 4 bytes:

- The first byte:

Bit0: Charging flag, set to 1 to indicate that the charging current is detected.

Bit1: Charging overcurrent flag, set to 1 means charging overcurrent is detected.

Bit4: Discharge flag, set to 1 to indicate effective discharge current is detected.

Bit5: Discharge overcurrent flag, set to 1 to indicate discharge overcurrent occurs.

Bit6: Discharge short-circuit flag, set to 1 to indicate discharge short-circuit occurs.

- The second byte:

Bit0: Battery detection line open circuit flag, set to 1 means that the battery detection line is open.

Bit1: Open circuit flag of the temperature sensing line, set to 1 to indicate that the temperature sensing line is open.

Bit4: Battery overvoltage flag, set to 1 to indicate battery overvoltage.

Bit5: Battery undervoltage flag, set to 1 means battery undervoltage.

Bit6: Too high total voltage flag, set to 1 to indicate that the total voltage of the battery pack is too high.

Bit7: Total voltage too low flag, set to 1 to indicate that the total voltage of the battery pack is too low.

➤The third byte:

Bit2: The cell temperature exceeds the upper limit of the charging temperature.

Bit3: The cell temperature exceeds the upper limit of the discharge temperature.

Bit4: The cell temperature is lower than the lower limit of the charging temperature.

Bit5: The cell temperature is lower than the lower limit of the discharge temperature.

Bit6: The battery cell temperature difference exceeds the upper limit of the charging temperature.

Bit7: The cell temperature difference exceeds the upper limit of the discharge temperature.

➤The forth byte, reserved.

6.1.3.2 "Current Value" is a 16-bit integer (int16_t), the unit is 0.1A, charging is positive and discharging is negative.

6.1.3.3 "Number of Cell Strings" is an 8-bit unsigned integer number (uint8_t), which represents the number of cells in series managed by the current BMS.

6.1.3.4 "Cell Voltage" is an array of 16-bit unsigned integer numbers, and the number of elements in the array is specified by "Number of Cell Strings". The unit of the array element is mV.

6.1.3.5 The length of "balanced state" is related to the "number of battery strings".

The "number of cell strings" is within 8 strings (inclusive), and the length of "balanced state" is 1 byte.

The "number of battery strings" is within 16 strings (inclusive), and the length of "balanced state" is 2 bytes.

The "number of battery strings" is within 24 strings (inclusive), and the length of "balanced state" is 3 bytes.

The "number of cell strings" is within 32 strings (inclusive), and the length of "balanced state" is 4 bytes.

➤The first byte:

Bit0: Battery 1 (close to the bottom of B-) balance on flag.

Bit1: Battery 2 balance open flag.

.....

Bit7: Battery 8 balance open flag.

➤The second byte:

Bit0: Battery 9 balance open flag.

.....

Bit7: Battery 16 balance open flag.

➤The third byte:

➤The forth byte:

6.1.3.6 "Cell temperature sensor quantity" is an 8-bit unsigned integer number (uint8_t), which represents the number of cell temperature sensors currently managed by the BMS.

6.1.3.7 "Cell temperature" is an array of 8-bit integer numbers (int8_t), and the number of elements in the array is specified by the "number of temperature sensing". The unit of the array element is ° C.

6.1.3.8 "MOSFET temperature sensing quantity" is an 8-bit unsigned integer number (uint8_t), which represents the current number of MOSFET temperature sensors managed by the BMS.

6.1.3.9 "MOSFET temperature" is an array of 8-bit integer numbers (int8_t), and the number of elements in the array is specified by "number of temperature sensing". The unit of the array element is ° C.

6.1.3.10 "Number of cycles" is a 16-bit unsigned integer (uint16_t), which means the current battery pack

The number of charges and discharges that have been passed.

6.1.3.11 "Remaining power" is a 16-bit unsigned integer (uint16_t), the unit is 0.1AH.

6.1.3.12 "Total Capacity" is a 16-bit unsigned integer (uint16_t), the unit is 0.1AH.

6.1.3.13 "Switch state" is an 8-bit unsigned integer (uint8_t), the meaning of each bit is as follows:

Bit6: Charging switch status, 1 means the switch is closed and charging is allowed.

Bit7: Discharge switch status, 1 means the switch is closed and discharge is allowed.

6.1.4 Example:

6.1.4.1 The upper computer sends: 7F 10 02 06 12 57

➤7F is SOL.

➤10 is ADD.

➤02 is VER.

➤06 is LEN.

➤12 is FUN.

➤57 is CKS.

6.1.4.2 BMS return: 7F 10 02 3B 12 01 00 00 00 10 00 10 A6 0D EB 0D

C3 0D B9 0D C2 0D F6 0D EA 0D E5 0D 05 0E E7 0D E5 0D EC 0D 05 0E F4

0D E2 0D E4 0D 00 00 02 11 12 01 11 03 00 78 00 C8 00 C0 E5

➤7F is SOL.

➤10 is ADD.

➤02 is VER.

➤3B is LEN.

➤12 is FUN.

➤01 00 00 00 is the battery pack status flag. Corresponding to each bit: the charging current is detected.

➤10 00 means that the charging current is 1.0A.

➤10 means 16 battery packs.

➤The voltage of the first battery cell of A6 0D is 3494mV.

- The voltage of the second battery cell of EB 0D is 3563mV.
- The voltage of the third cell of C3 0D is 3523mV.
- The voltage of the fourth battery cell of B9 0D is 3513mV.
- The voltage of the fifth cell of C2 0D is 3522mV.
- The voltage of the sixth cell of F6 0D is 3574mV.
- The voltage of the seventh battery cell of EA 0D is 3562mV.
- The voltage of the eighth cell of E5 0D is 3557mV.
- 05 0E ninth battery cell voltage is 3589mV.
- The voltage of the tenth E7 0D cell is 3559mV.
- The voltage of the eleventh cell of E5 0D is 3557mV.
- The voltage of the twelfth cell of EC 0D is 3564mV.
- 05 0E thirteenth battery cell voltage is 3589mV.
- The voltage of the fourteenth cell of F4 0D is 3572mV.
- The voltage of the fifteenth cell of E2 0D is 3554mV.
- The voltage of the sixteenth cell of E4 0D is 3556mV.
- 00 00 balance is not turned on.
- 02 means that there are two battery cores.
- 11 12 The temperatures detected by the two battery cells' temperature sensors are 17°C and 18°C respectively.
- 01 means there is a MOSFET temperature sensor.
- 11 The temperature detected by the MOSFET temperature sensor is 17°C.
- The 03 00 battery pack has gone through 3 cycles of charging and discharging.
- 78 00 remaining power 12AH.
- The total capacity of C800 is 20AH.
- C0 means that the charging and discharging MOSFETs are both on.
- E5 check

6.2 Monitoring 2

6.2.1 Command: 0x11.

6.2.2 Parameters: None.

6.2.3 Response:

The response contains the following paragraphs (arranged in order in the frame structure).

- Battery status information.
- Current value.
- The highest voltage.
- The lowest voltage.
- Total voltage.
- Maximum temperature.
- The lowest temperature.
- Number of cycles.
- Remaining power.
- Total capacity.
- Switch state.

6.2.3.1 "Battery Status Information" refers to 6.1.3.1.

6.2.3.2 "Current value" refers to the content of 6.1.3.2.

6.2.3.3 "Maximum voltage" is the highest voltage among all the cells in the battery pack, in mV.

6.2.3.4 "Minimum Voltage" is the lowest voltage among all the cells in the battery pack, in mV.

6.2.3.5 "Total voltage" is the total voltage of the current battery pack after adding all the cells, the unit is 10mV.

6.2.3.6 "Maximum temperature" is the highest temperature compared with all cell temperature sensors.

6.2.3.7 "Minimum temperature" is the lowest temperature compared with all cell temperature sensors.

6.2.3.8 "Number of cycles" refer to the content of 6.1.3.10.

6.2.3.9 "Remaining Power" refer to 6.1.3.11.

6.2.3.10 "Total capacity" refers to the content of 6.1.3.12.

6.2.3.11 "Switch state" refer to the content of 6.1.3.13.

6.2.4 Example:

6.2.4.1 Host computer sends: 7F 10 02 06 11 58

➤7F is SOI.

➤10 is ADD.

➤02 is VER.

➤06 is LEN.

➤11 is FUN.

➤58 is CKS.

6.2.4.2 BMS return: 7F 10 02 1B 11 01 00 00 00 14 00 45 10

33 10 1D 15 1E 1E 00 00 C2 01 F4 01 C0 B0

➤7F is SOI.

➤10 is ADD.

➤02 is VER.

➤1B is LEN.

➤11 is FUN.

➤01 00 00 00 is the status flag of the battery pack. Corresponding to each bit:
the charging current is detected.

➤14 00 means the charging current is 2.0A.

➤45 10 The highest cell voltage is 4165mV.

➤33 10 The lowest cell voltage is 4147mV.

➤The total voltage of 1D 15 battery pack is 54.05v.

➤The maximum temperature of 1E batteries is 30 degrees.

➤1E battery core temperature is at least 30 degrees.

➤00 00 The battery pack has passed 0 charging and discharging cycles.

➤The remaining power of 2C 01 is 30.0AH.

➤F4 01 total capacity 50.0AH.

➤C0 means that the discharging MOSFET is on and the charging MOSFET is on.

➤B0 checksum.

6.3 Read battery status information

6.3.1 Command: 0x14.

6.3.2 Parameters: None.

6.3.3 Response: 4 bytes, please refer to 6.1.3.1.

6.4 Read current value

6.4.1 Command: 0x15.

6.4.2 Parameters: None.

6.4.3 Response: 2 bytes, refer to 6.1.3.2 content.

6.5 Read cell voltage

6.5.1 Command: 0x16.

6.5.2 Parameters: None.

6.5.3 Response:

The response contains the following three paragraphs (arranged in order in the frame structure).

➤Number of battery strings.

➤Cell voltage.

➤Balanced state.

6.5.3.1 "Number of battery strings" refer to 6.1.3.3.

6.5.3.2 "Cell voltage" refers to the content of 6.1.3.4.

6.5.3.3 Refer to 6.1.3.5 for "balanced state".

6.6 Read temperature information

6.6.1 Command: 0x17

6.6.2 Parameters: None.

6.6.3 Response: The response contains the following two paragraphs (arranged in order in the frame structure).

Number of temperature sensations.

Battery core temperature.

6.6.3.1 Refer to 6.1.3.6 for "Quantity of Temperature Sensing".

6.6.3.2 "Cell temperature" refers to 6.1.3.7.

6.7 Read capacity information

6.7.1 Command: 0x18.

6.7.2 Parameters: None.

6.7.3 Response: The response contains the following three paragraphs (arranged in order in the frame structure).

Number of cycles.

Remaining power.

Total capacity.

6.7.3.1 "Number of cycles" refer to the content of 6.1.3.10.

6.7.3.2 "Remaining power" refers to the content of 6.1.3.11.

6.7.3.3 "Total capacity" refers to the content of 6.1.3.12.

6.8 Read switch status

6.8.1 Command: 0x1C.

6.8.2 Parameters: None.

6.8.3 Response: Refer to the content of 6.1.3.13.

6.9 Reading time

Some models do not support this function. If the response obtained by using "read time" is 00, 0, 0, 0:00:00, it means that the model does not support "read time" and "read history" ", "Set time" function.

6.9.1 Command: 0x22.

6.9.2 Parameters: None.

6.9.3 Response: 6 BCD codes of uint8_t type, respectively representing year, month, day, hour, minute and second. The "year" is based on the year 2000.

6.9.4 Example:

6.9.4.1 The upper computer sends: 7F 10 02 06 22 47

6.9.4.2 BMS returns: 7F 10 02 0C 22 17 05 12 10 30 50 83

➤ 17 05 12 10 30 50 means that the current date is 10:30:50 on May 12, 2017.

6.10 Read history

Some models do not support this function. If the response obtained by using "read time" is 0, 0, 0, 00, 00:00:00, it means that the model does not support "read time" and "read history" ", "Set time" function.

6.10.1 Command: 0x23.

6.10.2 Parameters: one byte, one of the following three characters.

- (uint8_t)0x00 means to start reading from the first record.
- (uint8_t)0x01 means that the previous record is read normally, continue to the next one.
- (uint8_t)0x02 means the last record was read incorrectly, reread the last record.

6.10.3 Response:

The response contains the following paragraphs (arranged in order in the frame structure).

- Read the status.
- Record the time.
- Automatic shutdown timing.
- Battery status information.
- Current value.
- Number of battery strings.
- Cell voltage.
- Balanced state.
- The number of batteries' temperature sense.

- Battery core temperature.
- Number of MOSFET temperature sensing.
- MOSFET temperature.
- Number of cycles.
- Remaining power.
- Total capacity.
- Switch status.

6.10.3.1 "Read Status" occupies one byte, which is one of the following four characters.

- (uint8_t)0xFF means reading error.
- (uint8_t)0x00 means no record.
- (uint8_t)0x01 means normal reading.
- (uint8_t)0x02 means that it is the last record.

6.10.3.2 "Recording time" refers to 6.9.3 content.

6.10.3.3 "Automatic shutdown timer", which is of uint16_t type, represents the remaining time of BMS automatic shutdown, in "seconds".

6.10.3.4 "Battery Status Information" Refer to 6.1.3.1.

6.10.3.5 "Current value" refers to the content of 6.1.3.2.

6.10.3.6 "Number of battery strings" refer to 6.1.3.3.

6.10.3.7 "Cell voltage" please refer to 6.1.3.4.

6.10.3.8 Refer to 6.1.3.5 for "balanced state".

6.10.3.9 "Battery core temperature sensing quantity" refer to 6.1.3.6 content.

6.10.3.10 "Cell temperature" refers to the content of 6.1.3.7.

6.10.3.11 "MOSFET Temperature Sensing Quantity" please refer to 6.1.3.8.

6.10.3.12 "MOSFET temperature" refers to the content in 6.1.3.9.

6.10.3.13 "Number of cycles" refer to the content of 6.1.3.10.

6.10.3.14 "Remaining power" refers to the content of 6.1.3.11.

6.10.3.15 "Total capacity" refers to the content of 6.1.3.12.

6.10.3.16 "Switch state" reference 6.1.3.13

6.11 Set time

Some models do not support this function. If the response obtained by using "read time" is 00, 0, 0, 0:00:00, it means that the model does not support "read time" and "read history" ", "Set time" function.

6.11.1 Command: 0x30.

6.11.2 Parameters: 6 BCD codes of uint8_t type, respectively representing year, month, day, hour, minute and second. The "year" is based on the year 2000.

6.11.3 Response: execute response.

The setting is successful: the response content is (uint8_t)0x01.

Setting failure: The response content is (uint8_t)0x02.

6.11.4 Example:

6.11.4.1 Host computer sends: 7F 10 02 0C 30 17 05 12 10 30 50 75

- 17 05 12 10 30 50 means to set the BMS clock to 10:30:50 on May 12, 2017.

6.11.4.2 BMS return: 7F 10 02 07 30 01 37

➤01 means the setting is successful.

6.12 Modify capacity information

6.12.1 Command: 0x32.

6.12.2 Parameters:

➤Number of cycles.

➤ Remaining power.

➤ Total capacity.

6.12.2.1 Refer to 6.1.3.10 for the "number of cycles".

6.12.2.2 Refer to 6.1.3.11 for "Remaining Power".

6.12.2.3 "Total capacity" refers to the content of 6.1.3.12.

6.12.3 Response: execute response.

➤ The setting is successful: the response content is (uint8_t)0x01.

➤ Setting failure: The response content is (uint8_t)0x02.

6.12.4 Example:

6.12.4.1 The host computer sends: 7F 10 02 0C 32 01 00 78 00 C8 00 F0

➤ 01 00 means to modify the cycle times of the battery pack to 1.

➤ 78 00 means to modify the remaining power of the battery pack to 12AH.

➤ C800 means to modify the total capacity of the battery pack to 20AH.

6.12.4.2 BMS return: 7F 10 02 07 32 01 35

➤ 01 means the modification is successful.

6.13 Charge and discharge MOSFET control

6.13.1 Command: 0x41.

6.13.2 Parameters:

➤ MOSFET mask.

Bit0~Bit5 are reserved.

Bit6: Allow charging control.

Bit7: Allow to control the discharge.

➤ MOSFET function code.

Bit0~Bit5 are reserved.

Bit6: 1 means "charging prohibited"; 0 means "remove prohibition".

Bit7: 1 means "discharge prohibited"; 0 means "disable prohibition".

6.13.3 Response: execute response.

The setting is successful: the response content is (uint8_t)0x01.

Setting failure: The response content is (uint8_t)0x02.

6.13.4 Example 1, discharge control:

6.13.4.1 Host computer sends: 7F 10 02 08 41 80 80 26

➤ 41 is the control function code.

➤ 80 means only intervene in discharging MOSFET.

➤ 80 means that the discharging MOSFET is prohibited from turning on.

6.13.4.2 BMS return: 7F 10 02 07 41 01 26

6.13.5 Example 2, release the discharge control, and prohibit the charging MOSFET from turning on:

6.13.5.1 Host computer sends: 7F 10 02 08 41 C0 40 26

- 41 is the control function code.
- C0 means to intervene in discharging and charging MOSFET at the same time.
- 40:

Bit6: 1 means "charging prohibited".

Bit7: 0, which means "discharge prohibited" is released.

6.13.5.2 BMS returns: 7F 10 02 07 41 01 26, indicating that the setting is successful.

6.13.6 Supplement

When "Charging prohibited" or "Discharging prohibited" is set, the corresponding MOSFET must be turned off.

But after "charging prohibited" or "discharging prohibited" is removed, the corresponding MOSFET may not be turned on.

Because after the prohibition is lifted, the state of the MOSFET is determined by the BMS analysis program: it may be turned on,

It is also possible to protect.

6.14 Read product information

6.14.1 Command: 0x20.

6.14.2 Parameters: None

6.14.3 Response: The response contains three ASCII characters, arranged in sequence in the frame structure, separated by spaces.

- Product name.
- Hardware version number.
- Software version number.

6.14.4 Example:

6.14.4.1 Host computer sending: 7F 10 02 06 20 49

6.14.4.2 BMS returns: 7F 10 02 1B 20 42 57 42 4D 2D 36 30
35 20 48 3A 76 30 32 20 46 3A 76 30 35 00 4F

- 42 57 42 4D 2D 36 30 35 corresponds to the ASCII code "BWBM-605", the table shows the model name.
- 20 field interval.
- 48 3A 76 30 32 corresponds to the ASCII code "H:v02", indicating the hardware version number.
- 20 field interval.
- 46 3A 76 30 35 corresponds to the ASCII code "F:v05", which represents the software version number.

6.15 Read product serial number

6.15.1 Command: 0x21.

6.15.2 Parameters: None

6.15.3 Response: A string of numbers of uint32_t type, the expression can be defined by yourself.

6.15.4 Example 1:

6.15.4.1 Host computer sends: 7F 10 02 06 21 48

6.15.4.2 BMS return: 7F 10 02 0A 21 00 00 00 00 44

➤ 00 00 00 00